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oacsfor, d/a ltr, 13 sep 1973

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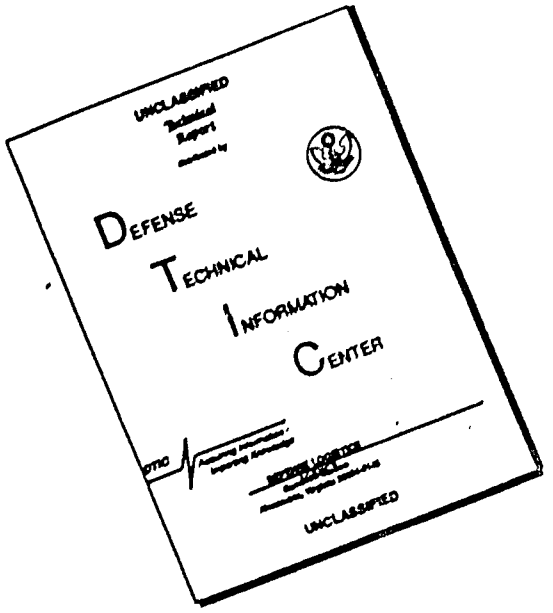

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ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96243

HELIBORNE ILLUMINATION SYSTEM

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JOINT RESEARCH AND TEST ACTIVITY
Office of the Director
APO San Francisco 96309

REPORT EVALUATION BY DIRECTOR, JRATA

It is extremely gratifying to review the evaluation report of a system which clearly provides improved, or new combat capabilities. Employment of the Heliborne Illumination System, in conjunction with other surveillance systems, has aided materially in interdicting Viet Cong movement during the hours of darkness. The Viet Cong, although harassed by daytime airstrikes, have enjoyed a large degree of freedom during night operations in the past. Wide spread use of this, or a similar illumination system, may have the effect of removing the cloak of darkness which now protects the Viet Cong.

During the time period 5 - 22 September 1965 the Heliborne Illumination System was used on fifteen night combat missions. These missions resulted in 23 sampans destroyed and 25 damaged; four boats and barges were sunk; and it is estimated that over 60 Viet Cong were killed during these attacks. Impressive as these figures are, they still do not accurately describe the potential of this type operation. This was a learning period, and in some cases the system was used for road reconnaissance, rather than for canal and waterway patrol where it has proved effective in restricting Viet Cong night operations. A captured Viet Cong stated that night helicopter operations against river traffic had decreased the mobility of his battalion. Battalion night river crossings which formerly required two hours to complete now require six to eight hours because of additional security precautions.

It is also noteworthy that the system looks extremely good from the cost-effectiveness standpoint. Although it is a cheap adaptation of existing equipment, (local cost of under $500 plus government furnished material valued at approximately $400) it has proved effective in the support of night interdiction and hamlet defense, and in the illumination of helicopter landing zones.

The findings, conclusions, and recommendations of the report are well substantiated, and I concur in them. Priority action should be given to procurement of four Heliborne Illumination Systems for each aviation battalion in the Republic of Vietnam, and two systems for each Division Aviation Battalion organic to US Forces in Vietnam.

Approved:

John K. Boles Jr.

25 October 1965

JOHN K. BOLES, JR.
Brigadier General, USA
Director

ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96243

FINAL REPORT

HELIBORNE ILLUMINATION SYSTEM

JRATA Project No. 2L-506.0

25 October 1965

Approved:

Hugh E. Quigley

HUGH E. QUIGLEY
Colonel, Armor
Chief

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AUTHORITY

Letter, AGAM-P(M) (17 Jul 64) ACSFOR, DA, 31 Jul 64, subject: Army Troop Test Program in Vietnam (U), as amended

CINCPAC Message DTG 130225Z January 1965

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Military Assistance Command, Vietnam (MACV)

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Technical and engineering assistance by the Advanced Research Projects Agency, Research and Development Field Unit-Vietnam (ARPA RDFU-V)

ACTIV is grateful for the assistance and cooperation given by the 119th and 197th Aviation Companies in furnishing aircraft and crewmembers for this evaluation.

PROJECT OFFICERS

Major Richard N. Thrower, Infantry

Major Bud Wallace, Infantry

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I. PREFACE

A. ABSTRACT

The purpose of the Heliborne Illumination System (HIS) project was to determine the operational suitability and concepts for effective employment of such a system in counterinsurgency operations in the Republic of Vietnam (RVN).

The HIS was designed by the Advanced Research Projects Agency, Research and Development Field Unit-Vietnam (ARPA RDFU-V) and fabricated in-country to supplement other methods of illumination in night combat operations. The HIS was flown under varying terrain, weather, and operational conditions on training and combat missions. Fifteen missions were observed by evaluators from the Army Concept Team in Vietnam (ACTIV). Additional data were gathered by interview and discussion with key personnel.

Although the HIS has not been optimized it did provide the US aviation companies a means of illumination for night combat missions, including target identification and engagement, reconnaissance of roads and canals, and illumination of landing zones. Because of the system's simplicity, minimum logistical and training requirements were imposed on the using units.

Prior to the completion of the evaluation, United States Army Vietnam (USARV) concluded that the system was suitable for employment in a counterinsurgency environment and placed a requirement on the Department of the Army, Assistant Chief of Staff for Force Development for funds and parts to build and issue the systems in-country. The system is being produced in sufficient quantities to provide each aviation battalion in RVN with [illegible]IS.

Generally, 2500 feet absolute was the most desirable altitude for the tactical employment of the HIS. An observer helicopter is normally required for surveillance of relatively small areas, troop formations, weapons emplacements, fortifications and similar-size targets. The observer helicopter follows the HIS just outside the light beam and at an altitude of 300 to 500 feet. A fire team of 3 armed helicopters trails 500 feet to the rear and at an altitude of 1500 feet absolute to provide protection for the searchlight and observer helicopter and also fire power for target engagement.

The HIS evaluated in this project is a satisfactory interim solution for the increased night illumination requirement. Although a step in the proper direction, it is not the optimum solution and research

should be continued to develop a standard aerial illumination system for combat operational use.

B. OBJECTIVES AND METHODS

1. Objective 1 - System Capability

Determine the capability of the system to provide sufficient illumination for night surveillance and operational missions in support of counterinsurgency operations.

To meet this objective, night operations were observed and documented, aircrews were debriefed following each mission, and comments solicited from US advisors.

2. Objective 2 - Tactics and Techniques

Determine tactics and techniques for employing the system in counterinsurgency operations.

The methods used for meeting this objective were the same as those used in objective 1. Questionnaires were used to obtain qualified professional opinion of tactics and techniques from aircrews, commanders, and staff personnel.

3. Objective 3 - Personnel and Logisitcs

Determine the personnel and logistical requirements including the basis of issue of the HIS in RVN.

To meet this objective, an examination was made of company records, interviews were held with aviation personnel, and the performance of operating and supporting personnel was observed and recorded.

C. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The Heliborne Illumination System is an effective source of light that provides airmobile companies with an organic capability to conduct limited night illuminated surveillance and operational missions. The tactics for employing the system are basically simple and depend primarily on the type of illumination desired and the type of operation being conducted. Very few logistical problems were encountered during the evaluation. The training of aircrews in the employment of the system required approximately 2 hours. The HIS should be issued as an interim piece of equipment on the basis of four per aviation battalion in RVN. Research should be continued to develop a standard aerial illuminated system. The possible adaptation of the Xenon tank-mounted searchlight as an heliborne illumination system is being explored by ACTIV and a supplemental report will be rendered upon completion of this project.

II INTRODUCTION

A. PURPOSE

The purpose of the Heliborne Illumination System project was to determine the operational suitability and concepts for effective employment of such a system in counterinsurgency operations in the Republic of Vietnam.

B. BACKGROUND

The Viet Cong, using the hours of darkness as natural cover, have successfully conducted night operations over a period of years in the RVN. One method of illumination, Mark 6 aircraft flares, has been only partially successful in providing adequate illumination at night to counter the Viet Cong operations. In July 1964, United States Army Support Command, Vietnam (now USARV) stated than an operational requirement existed for a heliborne illumination system.

Commander in Chief, Pacific (CINCPAC) approved the establishment of a project in two phases. In phase 1, Technical Feasibility, ARPA RDFU-V locally designed and developed a heliborne illumination system. Basic static, flight, and illumination tests were conducted by ARPA RDFU-V to determine operation of the system throughout the desired flight range. Based on the results of these tests, phase II, Operational Suitability and Employment, was warranted. ACTIV was directed to undertake the phase II evaluation.

C. DESCRIPTION OF MATERIEL

1. Light Fixture

The original light fixture tested consisted of a tubular frame so constructed that it could be securely attached to the cargo tiedown points of a UH-1 helicopter and firmly support a cluster of lamps. In addition, it was hinged in such a manner that it could be manually extended from the right cabin entrance and depressed to minimize feedback illumination of the cockpit/cabin area. When not in use, it could be retracted into the aircraft. Illumination was provided by seven 600-watt, 28-volt, sealed-beam lamps of the same type used in the US Air Force C-123 landing light system. These lamps were mounted with one lamp in the center and six equally spaced in a circle around it. The center lamp was rigidly attached to the metal frame. The peripheral lamps could be pivoted radially from the center to enlarge the area of illumination. The lamp mount was also pivoted so that by actuating a lever at the rear of the frame, the whole light beam could be aimed through an arc of about 20 degrees forward and 20 degrees aft of the

vertical and about 35 degrees upward to the right from the vertical toward the horizon. This system weighed 99 pounds (figure 1).

A second system, an improved version of the original and weighing only 66 pounds, was constructed to incorporate a number of minor changes. This system differed from the original in that heat-treated aluminum was used in the lamp brackets and other parts that were subject to stress and vibration, a different arrangement for aiming and focusing the lamps was made, and it was constructed so that it could be mounted in the left door of the cabin to lessen the adverse effect of glare on the pilot. Instead of having an individual switch to control each of the seven lamps, the new system had one simple off-on switch which controlled all lamps (figure 2).

2. Power Requirements

Each lamp requires slightly less than 22 amperes at 28 volts for a total requirement of about 150 amperes. The UH-1 generator is rated at 300 amperes, while normal operating load of the helicopter system is about 100 amperes, leaving enough power for the illumination system.

3. Illumination Capability

Theoretical calculations indicate that from a flight altitude of 2000 feet above the ground with the 7 beams parallel, a circular area 400 feet in diameter could be illuminated with an intensity of 0.735 foot-candles, or 35 to 70 times full moonlight. When the 6 outer beams are spread, a circular area 1200 feet in diameter can be illuminated with 0.105 foot-candles, or 5 to 10 times full moonlight. Similar calculations indicate that at 6000 feet altitude, areas with diameters of 1200 feet and 3600 feet can be illuminated with intensities of 0.062 and 0.012 foot-candles, under parallel and spread conditions, respectively. For comparison, a 60-watt, undirected tungsten lamp at 50 feet distance yields 0.08 foot-candles. Full moonlight is 0.01 to 0.02 foot-candles. (See figures C-1 and C-2, annex C.)

D. SCOPE

1. Definition of the Project

The project was undertaken to determine the capability of the Helicborne Illumination System to provide sufficient illumination for night visual aerial surveillance and other night combat operations as required. Assessment of concepts of employment, adequacy of illumination, and personnel and logistical requirements were made.

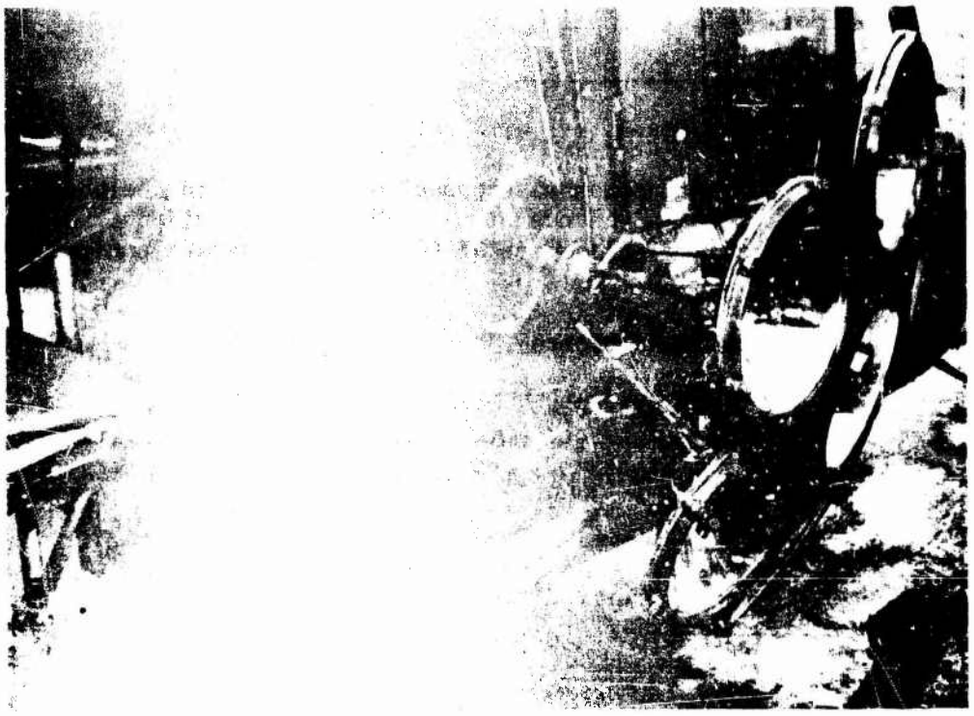

FIGURE 1. Original Heliborne Illumination System.

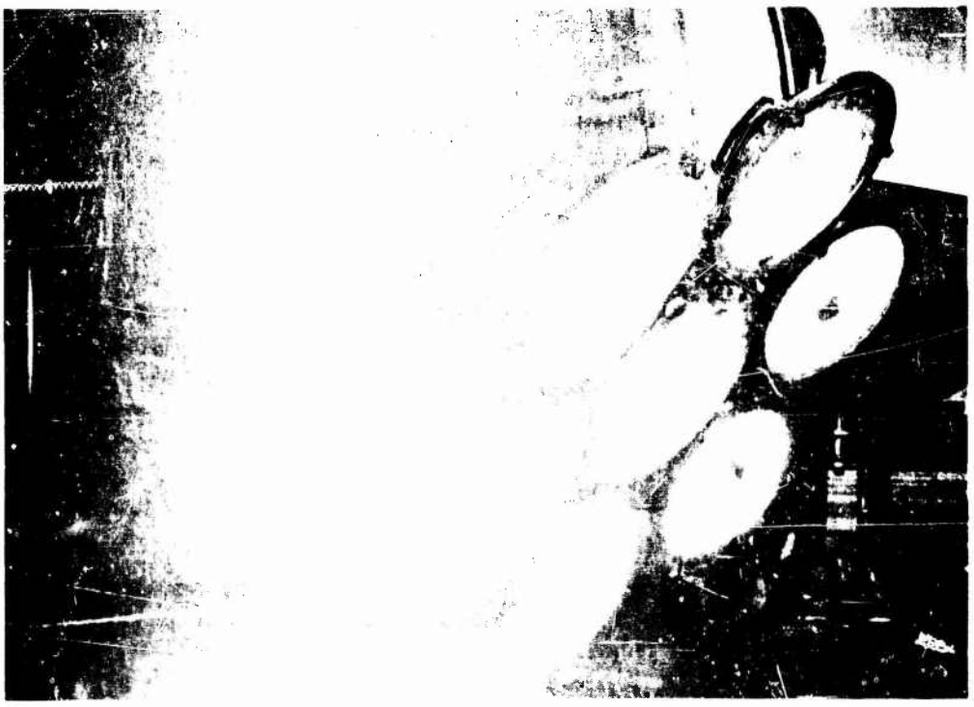

FIGURE 2. Second, improved Heliborne Illumination System.

2. Setting of the Project

a. Environment

The evaluation was conducted in the Mekong Delta, coastal plains, and central highlands of the RVN. This provided a representative cross section of all types of terrain and weather conditions found in the RVN.

b. Military Elements

The evaluation was conducted during training and combat operational missions that employed elements of the 119th Aviation Company, 52d Aviation Battalion and the 197th Aviation Company, 145th Aviation Battalion.

E. EVALUATION DESIGN

1. Methodology

a. Data Collection Methods

Project officers from ACTIV participated in the majority of the operations when the HIS was used. Discussions and interviews were held with crew members, US advisors, commanders and staff, Air Force liaison officers, and other participating personnel concerning all aspects of the system. The ACTIV project officers served as crew members for both the searchlight helicopter and armed and troop helicopters during the evaluation and flew 15 training and combat missions gathering information and data.

b. Analysis Methods

The analysis was essentially a study of the results obtained from using the HIS in 15 training and combat missions. The opinions of commanders, staffs, and advisors and after-action reports rendered by crew members were evaluated. Observations of operating and supporting personnel and reports of the project officers were also studied to determine the value and limitations of the Heliborne Illumination System.

2. Limitations and Variables

The HIS was issued to the two aviation companies which furnished UH-1 aircraft and crew members for the evaluation, and command and operational control of the system rested solely with that unit. Frequently, the aviation unit's requirement to have a maximum number of aircraft available for daylight missions precluded the use of the HIS at night. In addition, the southwest monsoon season began during the evaluation and low ceilings and visibility at night frequently caused cancellation of

pre-planned HIS missions. At no time during the evaluation were missions conducted solely for the purpose of collecting data.

3. Support Requirements

Project officers and enlisted administrative assistance were provided from ACTIV in-house resources. Temporary duty personnel were not required for the evaluation.

The two heliborne illumination systems used in the evaluation were manufactured locally by a civilian firm, engineer-tested by ARPA RDFU-V, and concept-tested by ACTIV. The systems were returned to ARPA RDFU-V upon completion of the evaluation.

4. Time Schedule

On 10 April 1965, the evaluation plan was submitted for approval and data collection began with a combat mission using the original illumination system.

The second, improved system was delivered on 4 June 1965 and was immediately incorporated into the tests. Data collection continued through 31 July 1965 in the II, III, and IV Corps tactical areas.

III DISCUSSION

A. OBJECTIVE 1 - SYSTEM CAPABILITY

1. Night Surveillance Operations

The HIS was evaluated to determine its capability to provide sufficient illumination for night surveillance missions. Flights were made at various altitudes, from 1500 to 3500 feet absolute, and at airspeeds from 50 to 70 knots. The terrain varied from delta rice paddies to wooded areas and mountains. It was determined that only large, contrasting objects the size of houses could be identified from the searchlight helicopter. This was attributed to the altitudes at which the system was being flown and feedback illumination which produced a halo effect around the searchlight. However, other helicopters following just outside of the light beam and at lower altitudes (500 to 1500 feet absolute) were able to use the light to navigate and readily identify terrain features on the ground.

2. Night Operational Missions

a. Target Identification and Engagement

On pre-planned missions when the nature and location of the target were known, it was possible for the searchlight helicopter to fly directly to the target and illuminate it. If only the general location of the target were known, the searchlight helicopter would proceed to the general area and then begin a search pattern until the target was located. Sufficient illumination was provided for other helicopters flying at a lower altitude (500 to 1500 feet) to definitely identify targets. By flying an orbital pattern the light was maintained on the target and provided sufficient illumination for the armed helicopters to engage the target. The decision to engage was made by the flight leader based on his observation of the target.

b. Night Landing Zone Operations

The Heliborne Illumination System was used to illuminate landing areas for formations of one to five helicopters. In most cases, the system provided sufficient illumination for helicopter crews to identify, approach, land, and take off from the landing zone area. In dusty areas, the helicopter landing light-searchlight system had to be used in order to maintain a horizontal reference through the swirling dust created by the rotor wash. One pilot reported a partial loss of night vision when taking off from an area lighted by the HIS. However, it was determined that this loss was no greater than that experienced when taking off from

an unlighted field using the helicopter landing-searchlight system.

It was found that one HIS provided sufficient illumination to light a landing zone large enough for simultaneous landing of five helicopters. A formation greater than five helicopters landing in a single LZ was not evaluated. However, it was obvious from the amount of illumination provided by the single HIS than a minimum of two systems would be required for formations greater than five helicopters.

3. Findings

It was determined that the system was capable of providing sufficient illumination to conduct night reconnaissance, night target identification and engagement, and night landings and takeoff

B. OBJECTIVE 2 - TACTICS AND TECHNIQUES

1. Night Surveillance Operations

The HIS was evaluated to determine tactics and techniques of employment in counterinsurgency operations. Observations were recorded of how each unit employed the system. No attempt was made by the ACTIV evaluators to influence or dictate how the system should be employed.

Initial attempts at night surveillance employed the HIS on a single ship mission, without observer or armed helicopters accompaning the searchlight helicopter. Feedback illumination from the HIS prevented observers in the searchlight aircraft from identifying anything on the ground except large, contrasting objects.

The tactic that eventually evolved was to employ the HIS at an altitude of 2500 feet absolute. For surveillance of relatively small areas, troop formations, weapons emplacements, fortifications, and similar size targets, an observer helicopter was required. This helicopter, following the HIS just outside the light beam and at a lower altitude (300 to 500 feet absolute), could readily identify small objects and individuals on the ground. The observer helicopter was blacked out; position and navigation lights and rotating beacon were extinguished. A fire team of 3 armed helicopters trailed 500 feet to the rear and at an altitude of 1500 feet absolute to provide protection for the searchlight and observer helicopter and also fire power for target engagement (figure 3).

For surveillance of traffic on canals and roadways and other large targets, the observer helicopter was not required. The armed helicopter following the searchlight could readily identify sampans, vehicles, and other similarly sized targets.

Generally, 2500 feet absolute was the most desirable altitude for the searchlight helicopter. This represented a compromise between

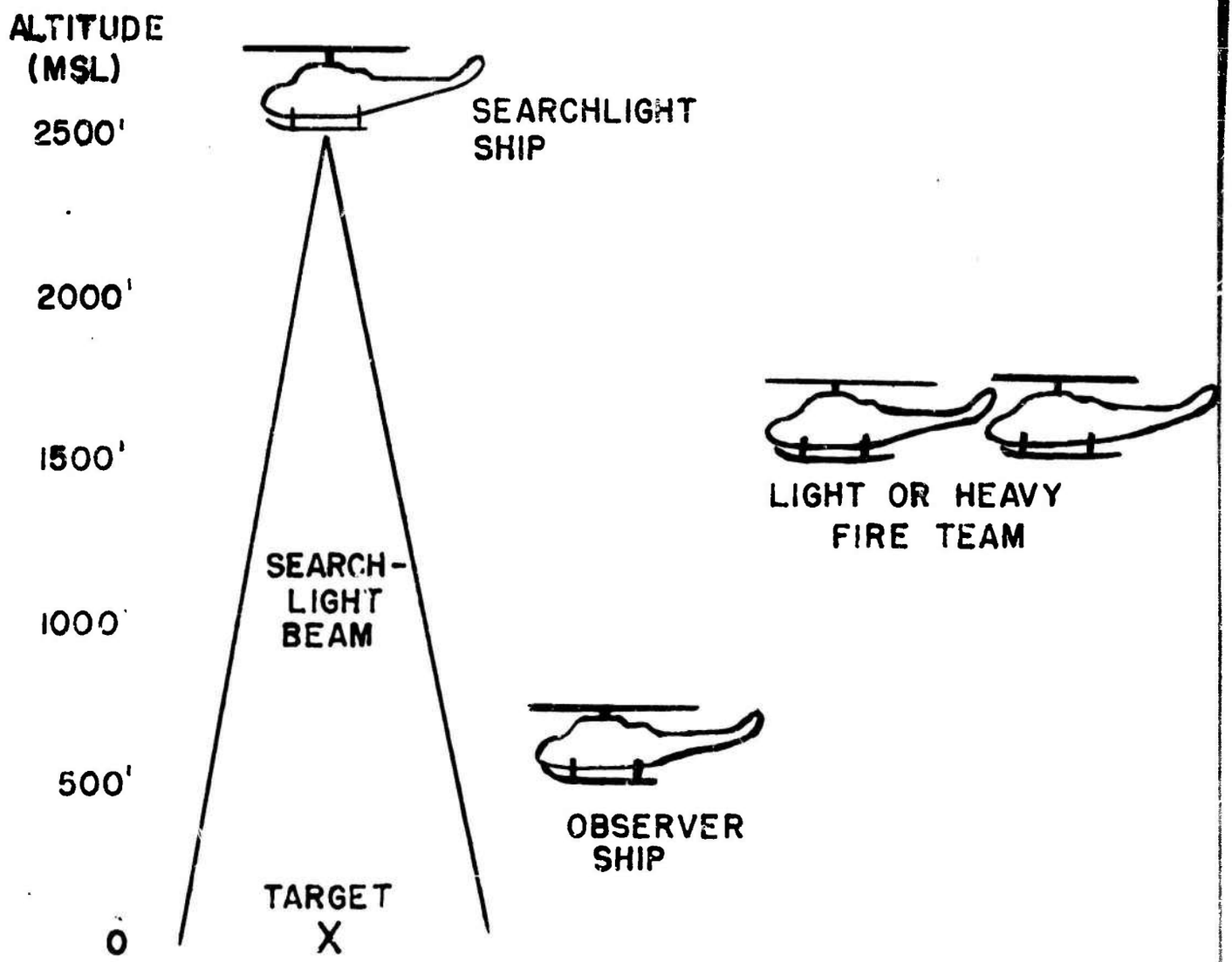

FIGURE 3. Profile view of tactics employed.

sufficient height to reduce vulnerability to small arms fire and enough proximity to produce the desired illumination on the ground. On nights when dust, haze, smoke, or other restrictions to visibility were present in the air, it was necessary to fly the searchlight helicopter at lower altitudes.

2. Night Operational Missions

a. Target Identification and Engagement

The tactics and techniques employed in night operational missions were generally the same as those used in night surveillance. Target location and tentative identification were frequently provided by OV-1B aircraft equipped with side looking airborne radar (SLAR). The HIS and armed fire teams were then vectored to the target location. After the target was identified, and the decision to engage had been made, the flight team leader issued a fire command over the radio. Elements of the fire command were: target, type of weapon system to be employed, direction of attack, and amount of ammunition to be expended. The HIS established an orbital pattern, maintaining illumination on the target throughout the engagement.

The armed helicopters began the target engagement at 1500 feet and ended their firing run at 1000 feet. Regardless of altitude, the firing run terminated prior to reaching the light beam to prevent exposure. During the target attacks the armed helicopters were blacked out. After completing the attack, the rotating beacons were turned on as the helicopters broke away from the target. The flight leader then reported the magnetic heading and altitude to which he was climbing.

If an observer helicopter were employed, the pilot immediately turned away from the light beam at the beginning of the engagement and turned on the rotating beacon so that he could be seen by the armed helicopters. When the observer helicopter was armed, it joined the other armed helicopters in engaging the target. If unarmed, the observer helicopter orbited well out of the target area and at an altitude above the searchlight helicopter.

b. Night Landing Zone Operations

The HIS was flown at various altitudes, from 1500 feet to 4000 feet absolute, to determine the optimum altitude required to provide sufficient illumination for night landings and takeoffs by helicopters. It was determined that the altitude of 2500 feet absolute above the landing zone provided sufficient illumination for the conduct of landings and takeoffs.

Three techniques were attempted to determine the optimum tactics to employ in the illumination of a night landing zone. Flight paths parallel to the landing helicopters and linear and orbital flight

paths above the landing zone were flown by the searchlight helicopter. Of the three techniques, the orbital flight path above the landing zone proved to be most effective. This technique allowed the searchlight crew to maintain the light on a single point and thus produce a more even intensity of light in the landing zone.

3. Findings

The HIS should be flown at 2500 feet absolute while illuminating a target area. This altitude provides a compromise between sufficient altitude to reduce vulnerability to small arms fire and enough proximity to obtain effective illumination of the target area. During periods of reduced visibility it may be necessary to fly at lower altitudes. An observer helicopter flying at 300 to 500 feet absolute may be required for identification of relatively small targets. Three armed helicopters flying below and behind the searchlight at 1500 feet absolute can provide target identification, protection to the searchlight and observer helicopters, and fire power for target engagement. Once the target is identified, the searchlight helicopter should begin an orbital pattern and maintain illumination on the target throughout the operation. For night illumination of landing zones, the searchlight helicopter should be flown in a circular pattern at 2500 feet absolute above the zone.

C. OBJECTIVE 3 - PERSONNEL AND LOGISTICS

1. Personnel Requirements

a. Searchlight Operators

US Army Support Command Vietnam (now USARV) Regulation 95-8, dated 6 April 1965, specified that the minimum crew for a UH-1B helicopter flying combat missions will be a pilot, copilot, a crew chief, and a gunner. In order to minimize the size of the aircrew of the searchlight helicopter, the crew chief was normally used as the searchlight operator.

The simple construction of the system permitted the crew chief to become proficient in manipulating the searchlight in a maximum of 2 hours. The crew chief quickly learned to coordinate his efforts with those of the pilot.

b. Pilot/Copilot

A maximum of 2 hours training in conjunction with the searchlight operator was required for the pilot/copilot team to become proficient in maintaining the light on a target. The pilot flew the aircraft while the copilot observed the effect and placement of the light. Corrections to the pilot and searchlight operator were given by the copilot in order to maintain the desired placement of the light beam. These corrections were given over the intercom system. During periods of radio

congestion, previously agreed upon hand and arm signals were effectively used.

2. Logistics

a. Installation and Removal

Installation and removal of the system presented no particular problems. After a demonstration of the proper installation and removal procedures, the crew chief could perform either task in a maximum of 15 minutes. The system was placed over four cargo tie-down points and secured by four "J"-shaped bolts (figure 4). The electrical cable for the system was fed through the left-hand ammunition chute to the outside of the helicopter and fastened to hard point fittings. The positive cable was connected to the battery terminal of the reverse current relay and the negative cable was connected to the main fuel ground (figure 5).

b. First Echelon Maintenance

First echelon maintenance of the system required no special training for the crew chief and was confined to care and cleaning of the system, lubrication of the moving slides and hinges, and spot painting of worn metal. The only replacement parts required during the evaluation were lamps. Removal and replacement of the lamps required no particular mechanical skill.

3. Basis of Issue

The HIS evaluated in this project should be issued to each aviation battalion in RVN on the basis of four per battalion. Normal operations require only one system but the additional systems would provide illumination for night landing zone operations for formations of more than five helicopters, and enable the units to conduct simultaneous night surveillance missions in different areas.

4. Findings

A maximum of 2 hours of training are required for the pilot-co-pilot-crew chief (searchlight operator) team to become proficient in employing the HIS. The helicopter crew chief is normally used as the searchlight operator. Because of the simple design and construction of the system, installation and removal is relatively easy and no more than 15 minutes are required for either task. The first echelon maintenance of the system is also simple and is limited to care, cleaning, and lubrication of the system and replacement of burned out lamps. The system should be issued to aviation battalions in RVN as an interim night illumination device on the basis of four per battalion.

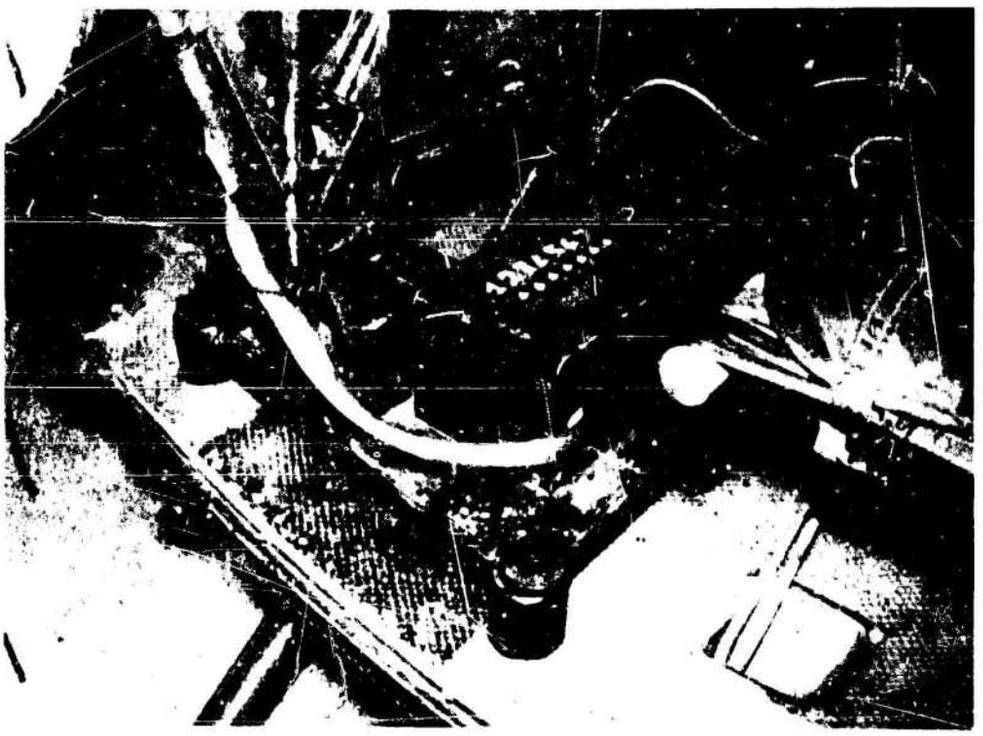

FIGURE 4. View of placement of Heliborne Illumination System inside helicopter cargo compartment

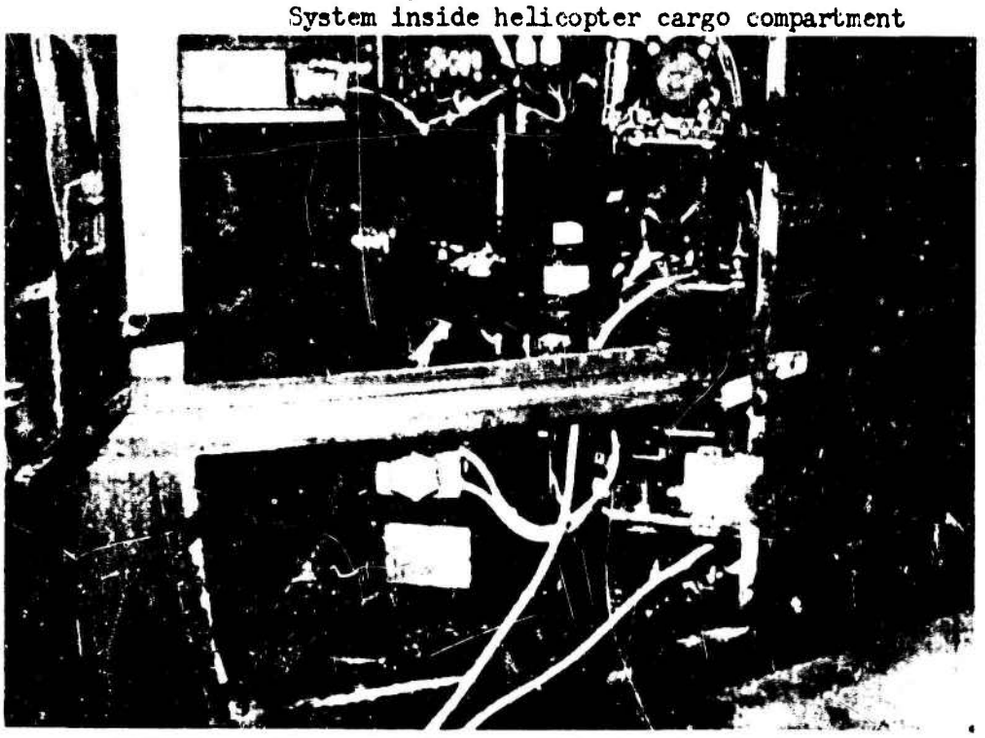

FIGURE 5. View of Heliborne Illumination System electrical connections to UH-1B helicopter

IV CONCLUSIONS AND COMMENDATIONS

A. CONCLUSIONS

It is concluded that:

1. The Heliborne Illumination System is an adequate interim device that provides sufficient illumination for night surveillance and operational missions in support of counterinsurgency operations.

2. The optimum altitude for employing the HIS is 2500 feet above the ground. This offers the best compromise between sufficient altitude to decrease vulnerability to small arms fire and enough proximity to place effective illumination on the desired target.

3. For surveillance of relatively small targets, an observer helicopter will be required. This helicopter, flying without lights at an altitude of 300 feet and outside the light beam, can easily identify targets.

4. A fire team of 3 armed helicopters flying at 1500 feet absolute provides sufficient protection for the searchlight and observer helicopters, and adequate fire power for target engagement.

5. Training of aircrews in the effective use of the system requires a maximum of 2 hours.

6. Because of the simple design and construction of the system, logistical support is minimal.

7. Four HIS per aviation battalion are adequate.

B. RECOMMENDATIONS

It is recommended that:

1. The HIS be procured and used in counterinsurgency operations in RVN.

2. The HIS be issued to aviation battalions in RVN on the basis of four per battalion.

3. Research be continued to produce a standard improved heliborne illumination device to replace the present in-country produced system. (ACTIV is conducting an evaluation of the Xenon searchlight mounted on the UH-1 helicopter. A supplemental report will be rendered upon completion of this evaluation).

ANNEX A

AFTER-ACTION REPORTS

This annex contains brief narrative summaries of some operations with the Heliborne Illumination System. They are not complete studies, but are intended to highlight certain activities during typical operations.

1. TRAINING MISSION IN THE COASTAL PLAINS REGION, 19 APRIL 1965

On 19 April 1965, a night training mission using the Heliborne Illumination System was conducted by the 197th Aviation Company, 145th Aviation Battalion. In addition to the searchlight helicopter, four armed UH-1B's participated in the training. The flight departed from Tan Son Nhut Airfield at 1935 hours and proceeded to Bearcat Range (coordinates YS155990).

The first mission was a point target consisting of a crossroad on Bearcat Range. The searchlight helicopter was flown in a circular pattern above the target at 2500 feet MSL and at an airspeed of 50 knots. Results were excellent. Pilots of the armed helicopters reported the searchlight provided sufficient illumination for them to place effective machinegun and rocket fire on the target area.

The second mission was an area target. The searchlight helicopter flew a linear pattern at 2500 MSL and 50 knots airspeed. Results were the same as for the point target. On both missions, the armed helicopters broke off their firing run before they reached the illuminated area. This prevented them from being exposed by the light.

The third mission was illuminating the airfield at Bearcat. One helicopter made takeoffs and landings on the runway using only the illumination provided by the searchlight. The altitude of the searchlight was varied from 2500 feet to 4000 feet and the airspeed was varied from 0 to 60 knots. Illumination effect on the ground was reported by the helicopter making the takeoffs and landings to be about the same at 2500 feet as it was at 4000 feet. However, the pilot reported a loss of night vision when a takeoff was made from the lighted area. Feedback light from the haze at 4000 feet prevented the searchlight operator from seeing the area on the ground that was being illuminated.

The final mission was to provide route illumination from Bearcat Range to Saigon. The altitude of the searchlight helicopter was 2500 feet and the airspeed was 70 knots. The searchlight provided sufficient illumination enroute for the pilot to navigate and to identify objects on the ground.

Mission returned to Tan Son Nhut at 2110 hours.

2. TRAINING MISSION IN THE COASTAL PLAINS REGION, 21 APRIL 1965

On 21 April 1965, a night training mission was conducted using the HIS. One searchlight helicopter and a platoon of five trooplift helicopters participated in the training. The flight departed from Tan Son Nhut Airfield at 1845 hours and proceeded to Bearcat Range (YS148988).

Formation landings and takeoffs were practiced by the platoon during the waning daylight. As darkness came, the searchlight was employed to light the landing zone.

An altitude of 2500 feet MSL and an airspeed of 60 knots were used during all illuminations. A circular pattern was used by the searchlight helicopter with excellent results. When a linear pattern was used, difficulty was experienced in maneuvering the searchlight over the landing zone at the precise moment the troop helicopters were landing. Additional training and coordination between the searchlight and troop helicopters may resolve the difficulty.

The flight returned to Tan Son Nhut at 2030 hours.

3. COMBAT ASSAULT MISSION IN THE DELTA REGION, 25 APRIL 1965

A combat assault mission employing the HIS was flown on the night of 25 April 1965. The flight, consisting of the searchlight helicopter and five armed helicopters, departed from Tan Son Nhut at 1800 hours and flew to the helipad at Tan An (coordinates XS5465). A briefing on possible locations of Viet Cong rest areas was received from the sector advisor. The flight departed from Tan An at 1945 hours and flew to the first objective area, near coordinates XS545675. An orbital search pattern was made by the searchlight helicopter until a group of thatched huts were observed. These were identified by an ARVN observer as the Viet Cong location. A Mark 6 flare was dropped at the location by an armed helicopter following the searchlight ship. The HIS was ordered extinguished by the flight leader. The suspected area was taken under fire by the armed helicopters using machineguns and rockets.

The second objective area, near coordinates XS497736, was illuminated and ground fire was received. Again, the area was marked with a Mark 6 flare and the HIS was extinguished. The target was taken under fire with machineguns and rockets.

The tactics in both of the above missions were to employ the HIS at 2500 feet in a search pattern of the objective area. One armed helicopter, with an ARVN observer aboard, trailed just outside the lighted area at an altitude of 500 feet. Upon identification of a target, a Mark 6 flare was dropped by the armed helicopter to mark the target and the

HIS was extinguished. The target was taken under fire by the armed helicopters flying at an altitude of 1500 feet behind the first armed helicopter.

The HIS was later used to illuminate a landing area in the vicinity of Thu Thua (coordinates XS535720). The landing helicopter reported excellent visibility provided by the HIS.

The flight returned to Tan Son Nhut at 2115 hours.

After initial illumination of both targets, the HIS was ordered turned off by the flight leader to prevent its receiving ground fire. It has since been requested by the ACTIV project officer that the searchlight helicopter be allowed to orbit an identified target and illuminate it during the firing runs by the armed helicopters.

4. NIGHT RECONNAISSANCE MISSION IN THE CENTRAL HIGHLANDS REGION, 22 MAY 1965

A flight consisting of the searchlight helicopter and two armed UH-1B's departed from Holloway Army Airfield at 2030 hours, 22 May 1965. The mission was night visual reconnaissance south along Route 14. Ten minutes were spent in the immediate area of the airfield to provide the aircrews an opportunity to practice in the use of the searchlight. One practice gunnery run was made on a simulated point target.

Route 14 south of Pleiku was identified with the aid of the searchlight and the reconnaissance mission was undertaken. The altitude of the searchlight was varied between 2000 and 3000 feet absolute because of the low cloud conditions along the route. After approximately 5 minutes of reconnaissance, the flight was directed by the battalion combat operations center (COC) to proceed to a point 1000 meters north of the airfield to investigate a suspected target picked up by ground radar.

A linear search pattern was established in the described area and was continued for 15 minutes. No sightings were made. The flight was informed by COC that the target had disappeared from the radar, and was directed to resume reconnaissance of route 14.

Initially, some difficulty was experienced in keeping the light beam on the roadway. After 5 to 10 minutes, the crew worked out their system of commands and adjustment of the light, and no further difficulties were encountered.

The armed helicopters flew at an altitude of 1000 feet absolute. The crews reported excellent visibility, and stated that the system provided sufficient illumination for them to identify individuals along the roadway.

No suspicious activities were sighted and the flight returned to Holloway Army Airfield at 2200 hours.

5. COMBAT ASSAULT MISSION IN THE COASTAL PLAINS REGION, 4 JULY 1965

A combat assault mission was flown on 4 July 1965 using the HIS. The 25th Division had requested an OV-1B (SLAR) for target acquisition along the Occidental and Oriental Rivers in their area, beginning at 2330 hours on 3 July. The HIS and a heavy fire team of armed UH-1B's were requested to be on stand-by alert at Tan Son Nhut. The heavy fire team consisted of two UH-1B's armed with the M-6 armament system (four 7.62mm machineguns) and one UH-1B armed with the XM-3 armament system (2.75-inch rockets).

The OV-1B was not available until 0045 hours on 4 July because of mechanical trouble. At 0120 hours, the OV-1B reported moving traffic on the Occidental River. At 0125 hours, the 25th Division ordered that the HIS and armed UH-1B's scramble. The flight departed from the airfield at 0135 hours (reaction time: 10 minutes from alert to liftoff) and proceeded directly to Duc Hoa. Over Duc Hoa the flight was directed to coordinates XS509674, northwest of Tan An, where the OV-1B had reported the moving targets on the river. Arriving at this location, the HIS was turned on and four sampans were observed. All four were tied up to the shore and were showing lights. A search was made of the immediate area but no moving traffic was observed. A search was begun up the river to the northwest. At coordinates XS504704, five sampans were observed moving in mid-stream. The target was illuminated and the armed UH-1B's engaged it. All five sampans were hit and two were reported sunk. Ground fire was received from coordinates XS4972. All ordnance was expended by the armed helicopters in suppressive fire in this area.

The tactic employed in this mission was to have the HIS fly at 1500 feet absolute and the armed helicopter at 1800 feet absolute. No observer ship was used.

6. COMBAT ASSAULT MISSION IN THE COASTAL PLAIN REGION, 16 JULY 1965

A combat assault mission was flown 16 July 1965 using the HIS. The operational requirement, target acquisition method, and target engagement remained the same as that previously used in conjunction with the OV-1B (SLAR). The fire team was composed of one UH-1B with M-6, one UH-1B equipped with two CBU-14B's (dispensers loaded with 114 BLU-3/B fragmentation bombs), and one UH-1B with a combination XM-3/M-5. The XM-3 in this combination carries only 24 to 36 rockets. The M-5 armament subsystem is an area fire weapon specifically designed for helicopters. It consists of: the M-75 launcher (gun) in a nose-mounted flexible turret containing elevating and azimuth drives; and a sighting station. The M-75 grenade launcher is an air-cooled, electric motor driven reciprocating barrel, 40mm, rapid firing weapon capable of launching fragmentation type

projectiles. The HIS was mounted in an armed ship, making a total of four armed aircraft.

The OV-1B (SLAR) reported a target on the Occidental River at coordinates XS438760. The HIS was turned on and five sampans were observed and taken under fire by the M-3/M-5 UH-1B. The rocket run was only partially successful and it was decided to use the CBU-14. A target engagement run was made employing the BLU-3 from the right dispenser; the left dispenser misfired. The run was very successful, resulting in four sampans sunk and one overturned. The team returned to Tan Son Nhut to re-arm and re-fuel. The misfired dispenser was moved to the right side to see if this would correct the malfunction.

The team departed the second time and was vectored back to the Occidental River, coordinates XS473708. The HIS was turned on and a moving target, a 30 to 35 foot motor launch, was located and tracked with the HIS. The rocket ship made a firing run and expended about three quarters of its load. The launch was hit and overturned following which approximately 30 to 35 VC were observed in the water. The CBU-14 was tried but again misfired. The M-5 was employed and also failed to fire. The door guns were then used to engage the swimmers. The HIS was extremely effective as it allowed the gunners to place accurate fire on the target of VC swimmers. It was estimated that all of the VC were killed.

The team departed from this area and returned to the original target at XS438760. The overturned sampan was still floating and as the team arrived, small arms fire was received from the south bank of the river. A .50 caliber machinegun was also firing from XS440771 and the rocket ship expended the remainder of his load on this target. The HIS was turned off and the HIS UH-1B reverted to the armed role. The .50 caliber machinegun was engaged and neutralized by the HIS UH-1B using 2.75-inch rockets. The remaining ordnance was expended over the area south of the river and the team returned to Tan Son Nhut.

7. COMBAT ASSAULT MISSION IN THE COASTAL PLAINS REGION, 19 JULY 1965

At 0145 hours on 19 July 1965, four armed helicopters of the 197th Aviation Company, with the HIS as the lead ship, were scrambled to engage Viet Cong night traffic on the canals South of Duc Hoa. Five minutes after takeoff the pilot of the fourth aircraft advised the flight he had lost his engine oil pressure and was starting an emergency descent. Because a high overcast blocked the moon, the terrain below was an indistinguishable black void that revealed no safe landing area. In the short seconds it took the stricken helicopter to autorotate to the ground, the HIS ship had swung back and illuminated the area so that all obstacles could be seen and avoided. The stricken ship, with the aid of the searchlight, was able to make a safe landing in a rice paddy avoiding the paddy dikes that unseen, could have been disastrous to the aircraft and crew.

The crews secured the area and a maintenance team worked throughout the night to replace the engine. A few hours later the aircraft was flown to its home base at Tan Son Nhut.

ANNEX B

SETTING OF THE EVALUATION

1. ENVIRONMENT

The Republic of Vietnam (RVN) occupies a crescent-shape area of about 67,000 square miles on the southeastern edge of the Indochina Peninsula. Although only 45 miles wide at the 17th Parallel, its demilitarized northern border with the Democratic Republic of Vietnam (North Vietnam), it has a seacoast of 1,500 miles on the South China Sea and Gulf of Siam, and western borders with Laos and Cambodia of about 900 miles. The land borders are poorly defined and drawn through difficult and inaccessible terrain.

a. Terrain

There are four distinct geographical regions: The highlands located in the north and central portion, the plateaus of the central highlands, the coastal plain, and the Mekong Delta in the South. See figure B-1.

The northern two-thirds of the RVN is dominated by a chain of broken mountains and rugged hills extending in a northwest-southeast direction and terminating on the northern edge of the delta plain about 50 miles north of Saigon, the capital. The area is characterized by steep slopes, sharp crests, narrow valleys, and dense vegetation. It is sparsely populated, mainly by primitive and nomadic tribes, and it contains few roads or trails.

The central highlands adjacent to the Laos-Cambodia border contain extensive plateau areas. Here, the mountains give way to more gently rolling terrain. The northern plateau is covered by almost impenetrable tropical forests and jungles, which often have two dense overhead layers of foliage at heights of about 40 and 125 feet. The southern portion is typical savannah country, with large open expanses covered by tropical grasses and open forests. This region is more heavily populated than the northern highlands and has more roads and trails.

The coastal plain, varying from 10 to 25 miles in width, extends from the 17th parallel to the Mekong Delta. At several places mountain spurs jut out to the sea, cutting the plains into a series of compartments roughly at Mui Dinh, Mui Ke Ga, Quang Ngai, Da Nang, and Hue, north of which the spurs become more frequent. The area is characterized by sandy beaches and dunes, backed up by rice fields, fertile areas, and marshes extending to the mountains. It contains many small cities.

The southern third of the country is part of the large delta

FIGURE B-1. Geographical regions, RVN.

plain formed by the rivers Hau Giang, Mekong, Vam Co, Saigon, and Dong Nai. The Hau Giang flows directly to the South China Sea. The huge Mekong splits into four branches, and the Vam Co and Dong Nai enter the Saigon before reaching the sea. In addition to these major tributaries, the area is cut by a number of smaller streams and a dense network of canals. The plain is relatively flat with few points exceeding an elevation of 20 feet above sea level. It is a very fertile area with more than 9,000 square miles under rice cultivation. Drainage is effected chiefly by tidal action, with the difference between ebb and flood as much as ten feet in some areas. The southernmost tip of the delta, known as the Ca Mau Peninsula, is covered with dense jungle, and mangrove swamps stand at the shoreline and on river estuaries. The eastern portion of the delta plain is heavily forested. The Plain of Reeds, a large marshy area covered with tall reeds and scrub trees, is located in the center of the delta region adjacent to the Cambodian border. During the rainy season, a major portion of the entire area is completely inundated.

b. Climate and Weather

The climate is hot and humid, subtropical in the north and tropical in the south where the monthly mean temperature is about 80 degrees Fahrenheit. The annual rainfall is heavy in most regions and torrential in many. It is heaviest at Hue which has an annual average of 128 inches. The low of 28 inches at Mui Dinh, a small cape on the eastern coast some 62 miles south of Nha Trang, results from the presence of hills in the area. At Saigon, rainfall averages 80 inches annually. See figure B-2.

Seasonal alternation of monsoon winds profoundly influences the weather throughout the year, although geographical features alter patterns locally. The winter monsoon blows generally from the northeast from early November to mid-March and often brings floods to the northern portion of the RVN. This is the period of the dry season in the delta, which usually lasts from December through March. The winds begin to shift in March, and with the exception of the coastal plain, high temperature and humidity prevail in all of the RVN from April to mid-June. The summer monsoon blows generally from the southwest from mid-June to late August or early September, bringing to the delta region heavy and frequent rains, high humidity, tropical temperatures, and maximum cloudiness. Mountains cause clouds to pile up and deposit moisture before the clouds reach the coastal plain or the northern highlands, which areas are dry during this period. In September the winds begin to shift again, and the coastal plain receives its maximum amount of rain and cloud cover, including severe tropical storms and typhoons.

c. Communications

Roads throughout the RVN are few in number, poorly cared for, and narrow. Road travel to major areas in the north is often stopped

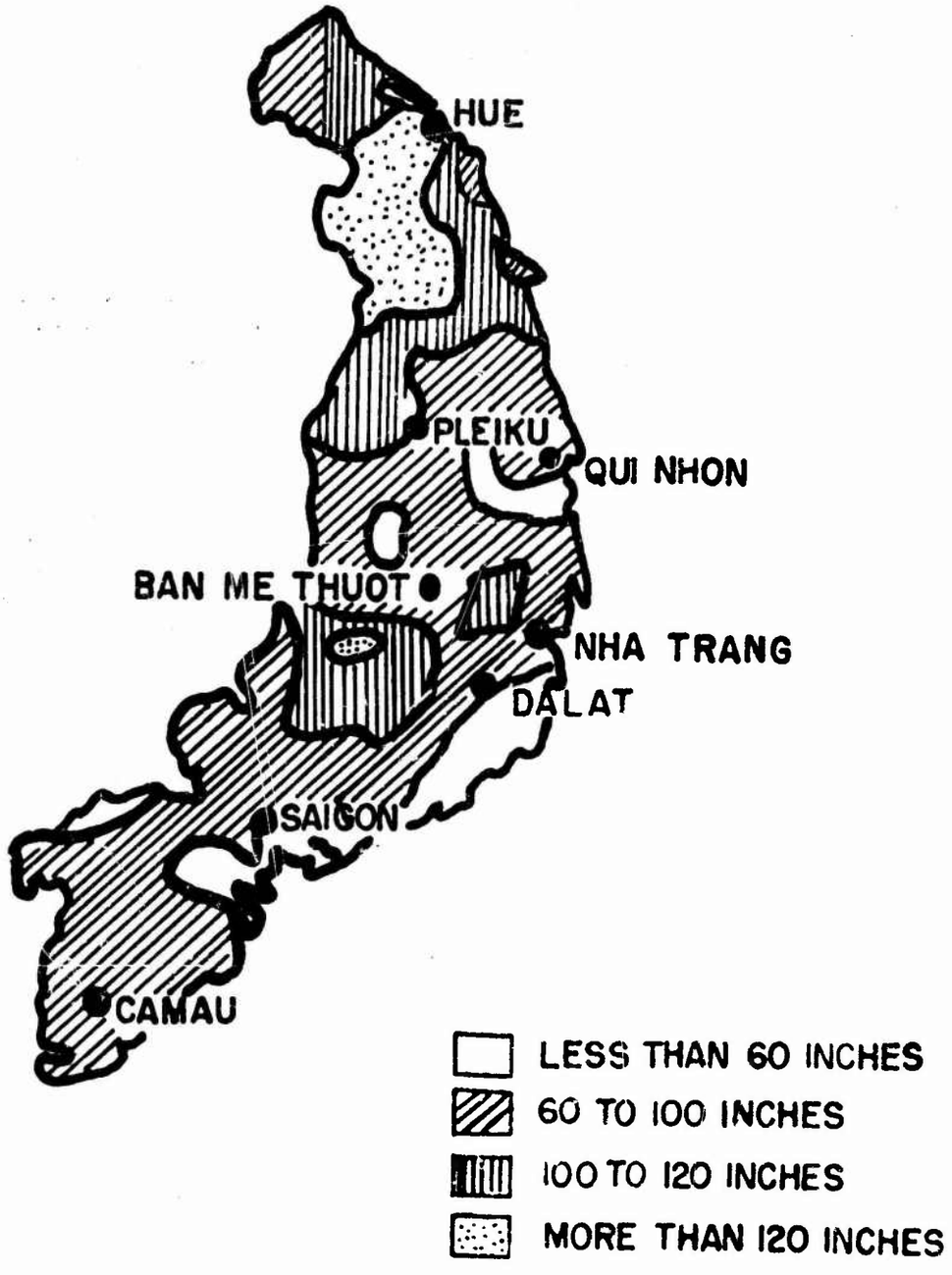

FIGURE B-2. Annual precipitation, RVN.

completely when bridges and narrow places are destroyed, either by natural causes or the Viet Cong (VC). In the delta region, 2,500 miles of navigable inland waterways ease somewhat the communication burden placed on the 1,200 miles of primary and secondary roads in the region.

A single-track, narrow gauge railroad connects Saigon with the northern provinces by way of the coastal plain. The system and equipment is old and frequently damaged by the VC.

There is no wire telephone communication among the major centers of population. What radio telephone service is available is at the mercy of the often unstable atmospheric conditions over the RVN. Telephone equipment used in major cities is antiquated or makeshift.

In effect, rural areas are virtually isolated. It is not unusual for a VC act of terrorism or sabotage to take place in an outlying delta area and be reported in Saigon a week or more later. Most incidents accounted for take at least two or three days to get into the situation reports to Saigon.

d. Popluation

The RVN has a population of approximately 15.7 million, with an average density of 234 per square mile. The highland region is generally the least settled of the geographic areas of the RVN, and the coastal plain contains the most people. About 90 percent of the people live on the 13 percent of the land best suited for rice cultivation: the delta and the small river basin of the coastal plain.

Racially, the population is composed of 85 percent ethnic Vietnamese, 6 percent Chinese (who have established a great influence on the economy of the RVN), 5 percent Montagnard (the nomadic aboriginal tribe people living in the highlands), 3 percent Khmer-Cham (of Cambodian descent), and 1 percent European, Indian, and other small groups.

Religiously, about 80 percent profess Buddhism, about 10 percent profess Catholocism, and the rest profess Muhammedanism, Hinduism, Protestantism, Cao Daism, or Hoa Haoism (two local sects).

Socially, there is an upper class composed of old mandarin families, landed gentry, government officials, professional men, intellectuals, clergy, and wealthy businessmen; an urban middle class of civil servants, teachers, and small businessmen; and a lower class, mainly composed of farmers, but with a growing group of urban workers. Mobility upward within the structure is possible but difficult, especially up from the lowest.

Vietnamese culture is based on traditional Chinese customs and has been profoundly influenced, especially among the upper class

living in the cities, by the French. Most rural Vietnamese continue to follow the traditional way of life. The great divergence in racial, religious, social, and cultural structures has produced continued strife and tension among the people who belong to the various groups. There seems to be no evidence of a permanent stabilizing force available within the Vietnamese society to control conflicting elements.

The Vietnamese have a deep and traditional belief in destiny and man's inability to change the natural order of events. This concept, reinforced by religious beliefs, results in a high valuation of the virtues of stoicism, patience, and endurance. The Vietnamese are proud of their ethnic traditions and hold themselves superior to ethnic minorities in the RVN and to the peoples of neighboring countries.

Most of the people living in the countryside, who make up 90 percent of the population and who provide the main targets for the VC, care neither for the government in Saigon nor for the VC. They want to be left alone to grow their corps, raise their families, have a tranquil old age, and die traditionally.

2. MILITARY ELEMENTS

a. Friendly

Units providing helicopters and aircrews for the evaluation of the HIS were selected primarily for their area of operation, the II and III Corps areas. This provided a representative cross section of all types of terrain and weather found in the RVN.

(1) Units

(a) 119th Aviation Company, 52d Aviation Battalion, Pleiku, RVN.

(b) 197th Aviation Company, 145th Aviation Battalion, Tan Son Nhut airfield, RVN.

(2) Missions

(a) The 119th Aviation Company provided airmobile support for the II Corps area.

(b) The 197th Aviation Company provided armed helicopter support for the III Corps area.

b. Enemy

It is a well-documented fact that the Communist apparatus in the RVN is an extension of the Communist party of North Vietnam, and that

direction and materiel and personnel support is received from the North. Supreme authority in the VC political and military organization in the RVN is the Central Office South Vietnam located in Tay Ninh Province near the Cambodian border. Subordinate thereto are four military regions and one special zone (corresponding roughly to the capital area), each of which has a subordinate series of provincial, district, and village-commune party committees.

(1) Units

The VC military force can be divided into 3 operational categories: main force, local force (together about 35,000 troops), and militia units (60,000 to 80,000 soldiers). The main local force units are controlled by province and district committees. They are well-organized, and the personnel are well-trained and well-equipped. Militia units are full and part-time local armed groups responsible to district, village, and hamlet authorities. Personnel of these units are used frequently as intelligence gatherers, porters, or as reinforcements for main and local force units. They may replace losses in the local forces.

A VC battalion is planned for 400 to 500 men, but in reality may consist of as few as 250. A company averages 100 men, and a platoon about 30. Personnel may be acquired voluntarily, by kidnapping, or by impressment using blackmail or threats of violence. There is evidence that large numbers (a total of about 45,000 in four years since 1960) of native born North Vietnamese have infiltrated from North Vietnam through Laos into RVN.

Viet Cong forces are in general lightly equipped and have a commensurate degree of cross-country mobility. In addition to individual weapons, they have a large number of automatic weapons, and light crew-served weapons. The large units are equipped with mortars and recoilless rifles. Supplies are obtained through capture, local procurement, taxation, and infiltration. Food staples such as fish, rice, and manioc are readily available.

(2) Capabilities

Because of support rendered by the country people, familiarity with the area, lack of responsibility for life and property, and the nature of guerrilla organization, equipment, and tactics, the VC are able to move virtually at will throughout much of the RVN. They are able to exploit as necessary the differences in race, religion, class, economic condition, and cultural background of their targets. They have a well-developed intelligence system, good discipline, and an usually effective security system.

Viet Cong military operations have the advantages of

speed, surprise, deception, and infiltration. Training, accomplished in small, local areas by well-indoctrinated cadre, probably emphasizes selection of the most vulnerable targets, night operations, movement as small units until concentration is required, terrorism and propaganda, use of weapons, employment of terrain and weather, and infiltration. The VC objective is not, at the present stage of their insurgency, to hold terrain, but rather to inflict losses on government forces, to capture weapons and material, and to convince the people that the government in Saigon cannot protect them and will eventually be defeated.

(3) Limitations

Viet Cong limitations stem from their need for strong security and the largely clandestine nature of their activities. Although the people among whom they live afford them a high degree of protection, active and passive, force must often be used, and support based on threats and fear endures only as long as pressure is brought to bear. Primitive living conditions add to the strain of avoiding government troops until the right moment. The VC are vulnerable to air and artillery attack, and less so to armor attack. Limited logistical capability, lack of communications, and insufficient medicine are other weaknesses.

ANNEX C

ARPA RDFU-V INTERIM REPORT

This annex contains a copy of the Interim Report of Evaluation, Heliborne Illumination System Study (JRATA Project 2L-506.0) rendered by ARPA RDFU-V.

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH AND DEVELOPMENT FIELD UNIT
APO San Francisco 96243

RDFU-V 1 June 1965

WED:rks

SUBJECT: Interim Report of Evaluation - Heliborne Illumination System Study (JRATA Project 2L-506.0)

TO: See Distribution List

1. References:

a. RDFU-V letter serial 390 dated 22 July 1964 with indorsement of Hq, USMSC-V.

b. JRATA letter serial 4801, subject: Project Proposal - Heliborne Illumination System, dated 25 November 1964 with one inclosure (evaluation plan) and first indorsement by Hq, USMACV.

c. RDFU-V letter serial 578, subject: Battlefield Illumination, dated 17 October 1964, with three indorsements.

2. Authority: CINCPAC message DTG 130225Z January 1965.

3. Purpose: The purpose of this project is to conduct a study of the required design characteristics for obtaining satisfactory battlefield illumination from a heliborne system.

4. Background:

Viet Cong night operations have created a continuing requirement for illumination. Since the insurgent uses all possible concealment, night provides a natural environment for him. An adequate illumination capability is essential not only for Vietnamese operations, but for any

counterinsurgency effort. This requirement is now met by use of the Mark 6 flare which is normally launched from a C-123 flareship. These flareships are not always available when required, nor is it reasonable to use them for every illumination requirement. It was suggested that a hand-held searchlight be mounted in helicopters in order to provide a lighting capability which would be organic with the helicopter units. A system of this type would provide a limited lighting capability to supplement the C-123 for lesser illumination requirements. By reference 1a, the US Army Support Command, Vietnam, stated the operational requirement for such a system and proposed fitting the light on a flexible mount and tapping power from the helicopter electrical system. There was an immediate need to study the illumination capability of such a system and its adequacy with respect to the needs for aerial surveillance and for assistance to our ground forces. Design of a lighting system with these characteristics was undertaken by the OSD/ARPA R&D Field Unit. Approval was obtained from the Army Materiel Command, 3rd Indorsement reference 1c, for the installation of this system in the UH-1B. An important criterion in the design was the development of a system which could be manufactured locally rather than to attempt the development of a system using the most modern techniques of illumination. In this way, it was possible to obtain a test device with the minimum delay and, at the same time, have the capability to rapidly produce the devices for use in the operational units if this proved desirable. It is believed that at least one year has been saved by following this development philosophy. The evaluation is being conducted in two phases, the first phase being a feasibility study by RDFU-V. Based on the results of Phase I, ACTIV would conduct Phase II, an operational suitability and concept evaluation. This interim report presents the results of the Phase I evaluation.

5. Description of Materiel:

a. Light Fixture: The heliborne illumination system consists of a tubular frame so constructed that it may be securely attached to the cargo tiedown points of the UH-1B helicopter and will firmly support a cluster of lamps. It is hinged in such a manner that it may be manually extended from the cabin entrance and depressed so that there is no feedback illumination of the cockpit/cabin area. When not in use it may be retracted into the cargo compartment, allowing the cabin door to be closed. Illumination is provided by seven 600-watt, 28-volt, direct-current, sealed-beam lamps of the type used in the USAF C-123 landing light system and produces 2.7 million candle power. The lamps are mounted with one lamp in the center and six equally spaced in a circle around it. The center lamp is rigidly attached to a metal frame. The peripheral lamps may be pivoted radially from the center to allow for concentration or diffusion of the area of illumination. The lamp mount is also pivoted so that by actuating a lever at the rear of the frame the whole light beam may be aimed through an arc of about 20 degrees forward and 20 degrees aft of the vertical and about 35 degrees about the longitudinal axis of the helicopter from the vertical plane toward the horizon. The entire system weighs 99 pounds.

b. Power Requirements: Each lamp is normally rated at slightly less than 22 amperes at 28 volts for a total calculated requirement of about 150 amperes. The UH-1B generator is rated at 300 amperes, while the normal operating load of the helicopter system is about 100 amperes, leaving enough power for the illumination system. The electrical load analysis is contained in Appendix A. The lamps are wired for individual selection in order to enable the variation of illumination intensity and electric power loads. Each of two rotary switches selects power to three of the peripheral lamps and one toggle switch operates the center lamp. On the final design the lamps will be individually protected by circuit breakers and one toggle switch will provide the power source for all lamps.

c. Illumination Capability: Theoretical calculations indicated that from a flight altitude of 2000 feet above the ground with the seven beams superimposed, a circular area 400 feet in diameter can be illuminated with an intensity of 0.735 foot-candles. When the six outer beams are spread, a circular area 1200 feet in diameter can be illuminated with 0.105 foot-candles. Similar calculations indicate that at 6000 feet altitude, areas with diameters of 1200 feet and 3600 feet can be illuminated with intensities of 0.062 and 0.012 foot-candles, under parallel and spread conditions, respectively. Details of these calculations are contained in Appendix B. For comparison, a 60-watt, undirected, tungsten lamp at 50 feet yields 0.08 foot-candles. Full moonlight is 0.01 to 0.02 foot-candles.

6. Discussion:

a. Preliminary Tests: This interim report covers the period 1 February to 10 April 1965. The illumination system was fabricated by Societe Anonyme de Mecanique Industrielle et de Construction (SAMICO) and delivered to OSD/ARPA RDFU on 1 February 1965. Upon receipt of the equipment, electrical tests were performed and the system was found to be satisfactory. The system was installed in a UH-1B helicopter to determine that it would attach securely and that the control devices were adequate. It was determined that one man could install the system in 15 to 20 minutes and remove it in approximately 10 minutes, with no modification being required of the helicopter.

b. Basic Flight Tests: Initial flight tests were performed during daylight hours to determine if any helicopter stability and control problems would be encountered from operating the system. A slight yaw tendency was evident during extension and retraction of the searchlight; however, this was easily countered by appropriate application of anti-torque pedal. The helicopter was flown through all normal maneuvers and practice autorotations; no adverse handling characteristics were noted. Maximum indicated airspeed was 85 knots. Throughout the operating envelope the searchlight operator was able to operate the focusing and aiming controls. The helicopter electrical loadmeter indicated 15 percent of rated generator power with normal system turned on; with the light on, the loadmeter indication was 60 percent, or approximately 135 amperes

being used for operation of the searchlight. Since these measurements using standard service instruments indicated a 40 percent electrical reserve during system operation, it was not considered necessary to install calibrated test instrumentation to isolate the apparent discrepancy between the 150 ampere calculated electrical load and the 135 ampere measured load. Approximately two hours of flight time were required for this test phase.

c. Basic Illumination Measurements: Flights were conducted to qualitively evaluate the amount of illumination delivered by the system. The degree of illumination produced is approximately equal to that of the Mk 6 flare; however, the area of illumination is considerably smaller. The light beam was placed outside the perimeters of defensive outposts and American advisors stated that the light was excellent and small details could be detected at ranges of 75 to 100 meters and that the illumination capability was usable at even greater ranges. Remarks of observers substantiated the theoretical calculations of illumination intensity, map inspections likewise substantiated the calculation of area coverage. Subsequent testing by ACTIV will provide further data on illumination capability of the device. It was found that the amount of backscattered light when operating in hazy conditions could be sufficient to make it impossible for the operator to see the ground. Under these conditions, observers in other helicopters reported that the ground illumination was not appreciably diminished. Employment of the system in haze would therefore require coaching the pilot and/or operator by radio to assist in properly positioning the light. Eight flight hours were required for this phase.

d. Operational Flight Tests: The illumination system was demonstrated to personnel of the US Army Support Command - Vietnam (USASC-V), Aviation Battalion Commanders and to Aviation Company personnel. All personnel expressed satisfaction with the amount of illumination produced. The system was used during several night training exercises and once during an actual night firing mission. Aviation company commanders stated that there was sufficient light to conduct a company-sized night airmobile operation. USASC-V personnel expressed a desire to purchase additional systems for subordinate units. RDFU-V has obtained a list of standard electrical components to be used in the construction of the system. This has been furnished to USASC-V for consideration. Twelve hours of flight time were required for this phase.

e. Equipment Modifications: The following modifications were made to improve the operation:

(1) One coat of heat resistant aluminum paint and two coats of heat resistant black paint were applied to the back of each sealed beam lamp to reduce the backlight from the system.

(2) A screw jack and handwheel system was installed to replace original wire and lever system of focusing.

(3) The aiming control handle and associated linkages were removed and replaced with a handle mounted directly to the lamp array.

f. Maintenance and Logistics: During the course of the evaluation no maintenance other than operator type was required on the system. There were no failures of electrical components; however, two hinges that attach the outer lamp brackets to the center lamp bracket were broken. This required fabrication of a new center ring assembly. SAMICO has been requested to increase the size of these hinges and/or use a different system of heat treating the casting. It was necessary to cover certain shiny surfaces of the aircraft with green cloth tape to reduce reflections back into the cabin area. These surfaces were places along the cargo floor edge and skid where the paint had worn off, exposing the underlying metal.

7. Findings: During the conduct of the evaluation it was found that:

a. The illumination system was aerodynamically compatible with the helicopter.

b. The illumination system was electrically compatible with the helicopter.

c. The time required to install and remove the system would permit normal daylight missions to be performed by the helicopter without the system installed.

d. The degree of illumination produced was approximately equal to that of the Mk 6 flare; however, a smaller area was illuminated.

e. The system provided adequate illumination for hamlet and outpost defense and for air support of night counterinsurgency operations.

f. The minor modifications made to the system improved the operational capability.

g. Only minor operator maintenance was required on the system.

8. Conclusions: As a result of the Phase I evaluation it is concluded that:

a. The heliborne illumination system provided satisfactory illumination for use in air-supported night counterinsurgency operations.

b. The system meets the requirement for devices organic to airmobile companies to supplement other illumination means.

9. RECOMMENDATIONS: It is recommended that:

a. ACTIV conduct Phase II of the evaluation to establish the operational suitability and the combat employment techniques for the system.

b. One additional system be procured using standard electrical components available through normal supply agencies.

c. The second system be used in addition to the present system during the ACTIV evaluation to determine any required design improvements.

d. That USASC-V be provided with detailed drawings and component lists so that expedited action may be taken on local procurement of additional illumination systems for operational use.

s/N. A. Rieke
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Acting Chief

2 Incl
Appendix 1
Appendix 2

APPENDIX 1 TO ANNEX C

ELECTRICAL LOAD ANALYSIS

1. Referring to TM 55-1520-211-20, Part II, Organizational Maintenance Manual, Army Models UH-1B Helicopters, dated 29 July 1964, page 1-4, Figure 1-2, UH-1B Helicopter Power Loading Chart, for the electrical load analysis, we obtain the following data:

EQUIPMENT LOAD DURING SEARCHLIGHT OPERATIONS:

a.	Magnetic Brake	1.5 amperes
b.	Engine Oil Temperature	0.1
c.	Gyro compass	0.8
d.	Cockpit lights	0.3
e.	Instrument and edge lights	5.2
f.	Master caution panel	0.2
g.	Anti-collision light	3.0
h.	Relay, battery	0.6
i.	Relay, non-essential buss	0.6
j.	Relay, buss control	0.3
k.	Inverter, main	16.7
l.	Fuel boost pump	5.0
m.	Solenoid valve, governor bypass	1.0
n.	Actuator, govern RPM	0.9
o.	Radio compass (ADF)	2.8
p.	VOR receiver (VHF)	2.9
q.	FM homing adapter	1.0
r.	FM auxiliary receiver	0.1
s.	FM transceiver (receiver)*	4.9
t.	UHF transceiver (receive)*	17.0
	(additional for transmit)*	3.0
u.	VHF transmitter (standby)	1.5
v.	Relay, intercom	0.2
w.	Signal distribution panel	0.6
x.	Relay, auxiliary signal distribution panel	0.1
y.	IFF transponder	4.5
z.	IFF adapter	4.2
aa.	Radar altimeter	3.0
bb.	Fire detection	0.1
	TOTAL:	82.1

EQUIPMENT TURNED OFF DURING SEARCHLIGHT OPERATION

a.	Pitot tube heater	4.0 amperes
b.	Cabin heater	31.1
c.	Engine anti-icing	11.0
d.	Heated blanket outlets	20.0
e.	Red dome light	2.6
f.	Fuselage light	12.6
g.	Searchlight	17.0
h.	Windshield wiper	3.5
i.	Cargo hook release	10.2
j.	FM transceiver (transmitting)	1.4
	TOTAL:	113.4

*It is assumed that only one transmitter is in use at any given time, and that is taken to be the UHF transmitter since it is the transmitter which presents the greater electrical load.

2. The maximum electrical load for battery charging is 130 amperes. This is for the condition of a completely discharged battery. The battery is normally recharged within ten to fifteen minutes after starting and requires far less than the listed 130 amperes.

3. Each lamp is on an individual circuit with its own circuit breaker. It is thus possible to cut the electrical load of the illumination system by pulling the desired number of circuit breakers. Each lamp requires about 22 amperes. If it were desired to operate the system immediately after take-off in an aircraft that had a low battery, it might be necessary to operate with less than seven lamps for a short period. By observing the electrical load which is installed in all UH-1B aircraft, it is a simple matter to restrict the electrical load to the 300 ampere capacity of the generator on those rare occasions when the demand is greater than the supply.

APPENDIX 2 TO ANNEX C

ILLUMINATION CALCULATIONS

600 watt lamp, 6° half angle beam.

Theoretically, 55 lumen are produced per watt, or 33,000 lumens for a 600 watt lamp. A tungsten lamp is approximately 40% efficient in converting electrical power to light in the visible spectrum, the remainder of the power going into heat and non-visible radiation. Thus, each lamp will radiate about 13,200 lumens in the visible spectrum.

The foot-candle is a measure of illumination equal to the number of lumens per square foot. The area illuminated is about $A = h \text{ sine } 6^{\circ})^2$ where h is the altitude above ground level of the helicopter. Hence, the average illumination obtained from one lamp will be 13,200/A foot-candles. The illumination for several lamps is an additive function of the individual illuminations. For the helicopter illumination system evaluated herein, the superposition of all seven beams would yield seven times the number of foot-candles illumination calculated for a single lamp. A graph presenting the illumination in foot-candles obtained from a single lamp at altitudes up to 6000 feet is presented in figure C-1.

The area illuminated by the array of lamps will depend on the positioning of the outer ring of lamps. The maximum area will result when the beams are just touching, which will provide about three times the diameter of the illuminated area for a single beam. The graph at figure C-2 presents the diameter of the illuminated area for a single beam versus the altitude of the lamp as well as the maximum diameter that may be illuminated with this system. The shaded area on this graph represents the attainable illuminated areas with this system.

The luminosity of the system may also be calculated since luminosity is simply lumens per steradian. It is found that the luminosity is about 384,000 beam candlepower per lamp. Thus, the array of seven lamps can be positioned to produce a 12° beam with about 2.7 million beam candle-power. This is a somewhat brighter source than the Mark 6 flare which has a nominal two million candle-power, but it must be noted that the flare is an omnidirectional emitter and will therefore illuminate a much larger area than the lighting system.

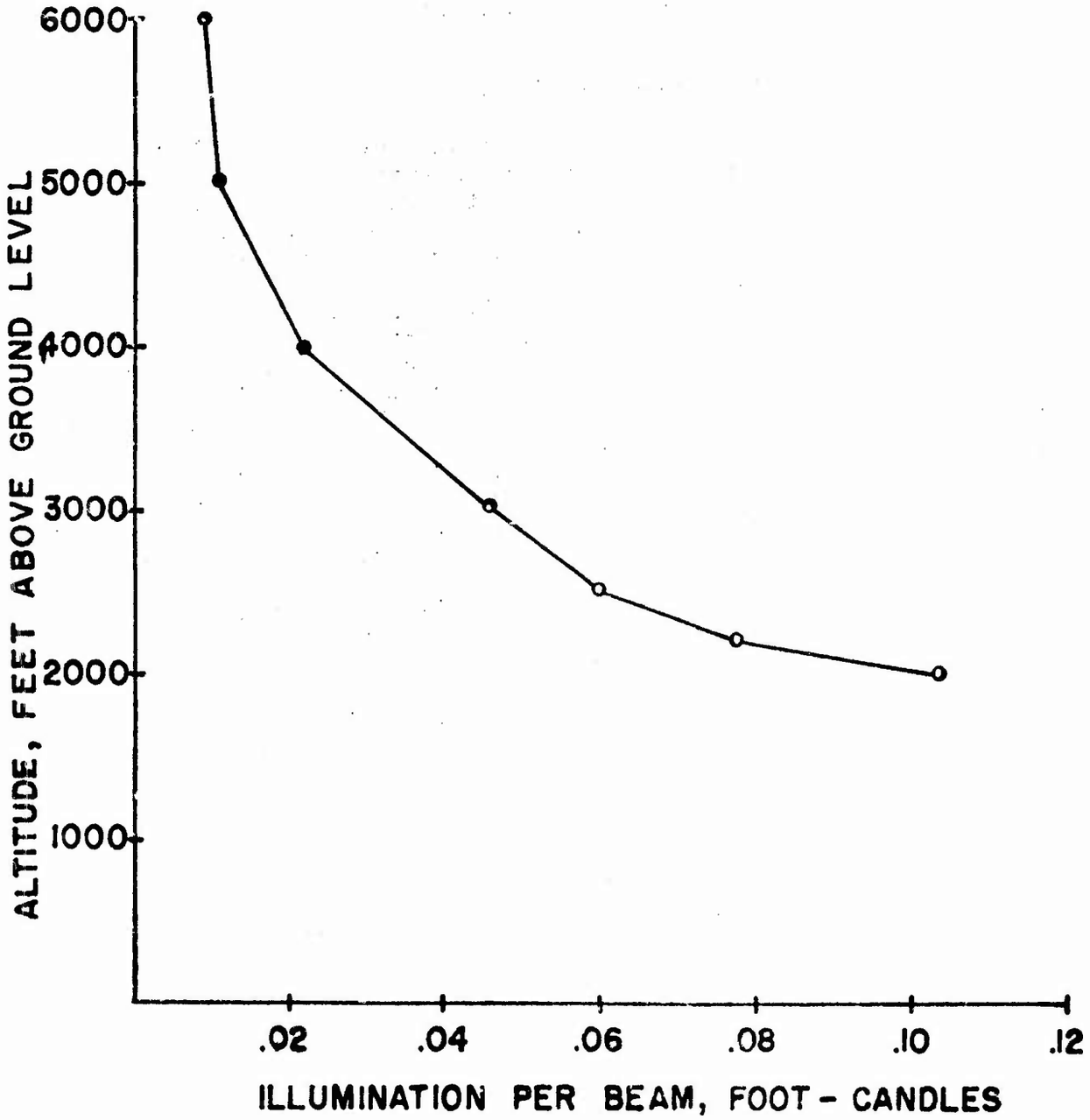

FIGURE C-1. Single lamp illumination in foot-candles.

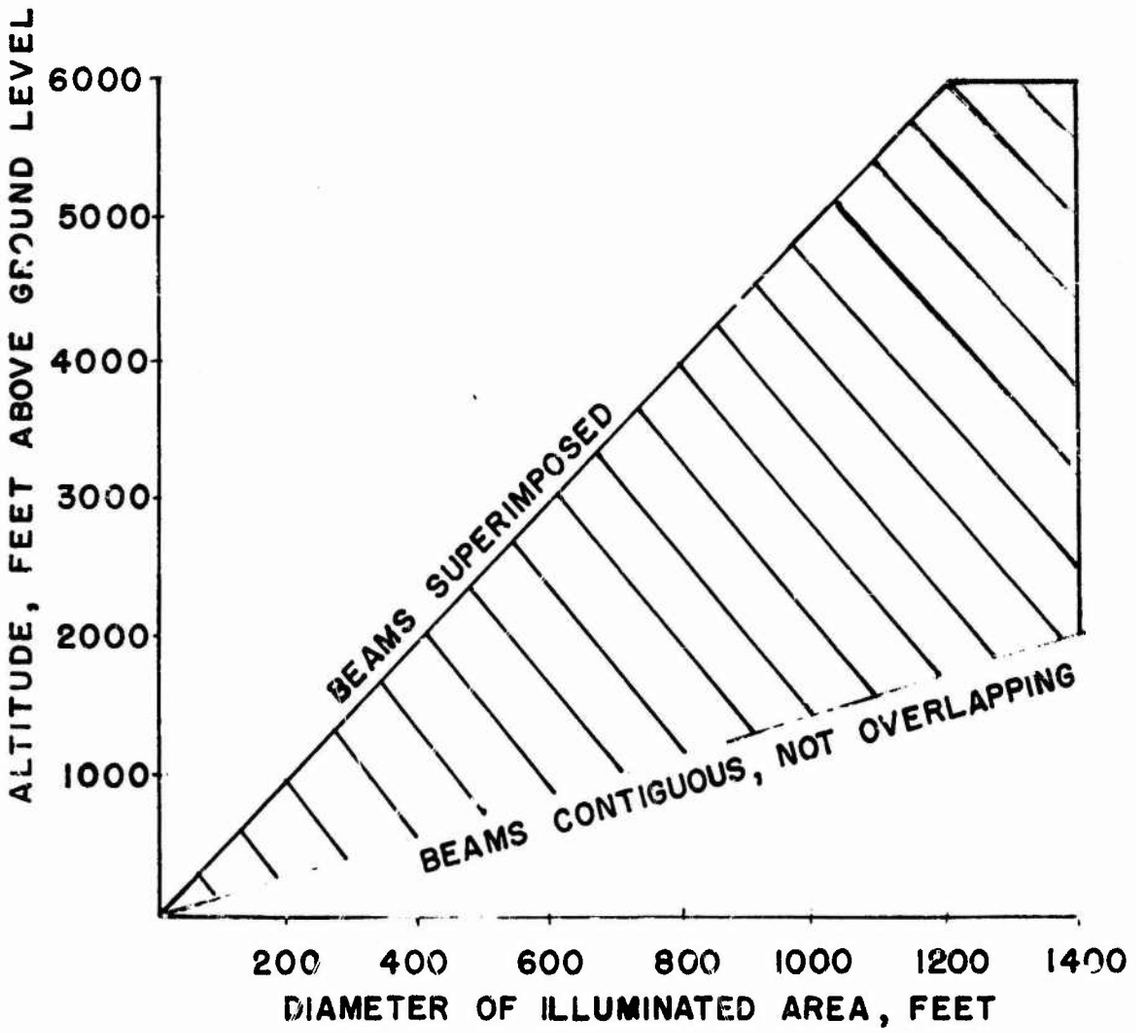

FIGURE C-2. Area of single beam illumination versus altitude.

ANNEX D

EQUIPMENT FAULTS

1. DEFICIENCIES

None

2. SHORTCOMINGS

None

3. CORRECTED DEFICIENCIES

Deficiency	Corrective Action	Remarks
a. Cracks and breaks developed in lamp brackets.	ACTIV had brackets fabricated locally from steel.	Second system incorporated the use of heat treated aluminum in lamp brackets.
b. Three switches had to be activated to turn on all seven lights.	New system incorporates single switch.	This reduced time required to activate/deactivate the system.
c. Original system was mounted in right door. This required the copilot to fly the aircraft while the pilot directed the searchlight.	New system is mounted in left door.	This allows the aircraft to be flown by the pilot.

ANNEX E

REFERENCES

1. ARPA letter, serial 630, subject: Project Proposal - Heliborne Illumination System Study, dated 9 November 1964.

2. JRATA letter, serial 4750, subject: Project Proposal - Heliborne Illumination System (JRATA Project Number 2L-506.0), dated 15 November 1964.

3. JRATA DF, subject: Project Establishment, dated 25 November 1964.

4. JRATA letter, serial 4801, subject: Project Proposal - Heliborne Illumination System (JRATA Project Number 2L-506.0), dated 25 November 1964.

5. CINCPAC message, DTG 130225Z January 1965, subject: Project Proposal - Heliborne Illumination System.

6. JRATA Menorandum, serial 5384, subject: Project Proposal - Operational Suitability and Combat Employment of a Heliborne Illumination System (2L-506.0), dated 1 April 1965.

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Security Classification

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10. AVAILABILITY/LIMITATION NOTICES

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	US Army Combat Developments Command Ft. Belvoir, Virginia

13. ABSTRACT The Heliborne Illumination System was designed by the Advanced Research Projects Agency, Research and Development Field Unit-Vietnam (ARPA RDFU-V) and fabricated in-country to supplement other methods of illumination in night combat operations. The HIS was flown under varying terrain, weather, and operational conditions on training and combat missions. Fifteen missions were observed by evaluators from the Army Concept Team in Vietnam (ACTIV). Additional data were gathered by interview and discussion with key personnel.

Generally, 2500 feet absolute was the most desirable altitude for the tactical employment of the HIS. An observer helicopter is normally required for surveillance of relatively small areas, troop formations, weapons emplacements, fortifications and similar-size targets. The observer helicopter follows the HIS just outside the light beam and at an altitude of 300 to 500 feet. A fire team of 3 armed helicopters trails 500 feet to the rear and at an altitude of 1500 feet absolute to provide protection for the serachlight and observer helicopter and also firepower for target engagement.

The HIS evaluated in this project is a satisfactory interim solution for the increased night illumination requirement. Although a step in the proper direction, it is not the optimum solution and research should be continued to develop a standard aerial illumination system for combat operational use.

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